

A Visualization of Dementia Care Skills Based on Multimodal Communication Features

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Abstract

We have developed a visualization system of dementia care skills based on multimodal communication features. The purpose of our system is to provide effective learning of dementia care to trainees. As dementia care skills are difficult to visualize and describe, they are hard to acquire for trainees. We focus on Humanitude[®]; a non-pharmacological comprehensive intervention with verbal and non-verbal communication, which is a care methodology of French-origin for the vulnerable elderly. The multimodal methodology utilizes four techniques to relate to elderly with dementia (i.e., gaze, speak, touch, opportunities to stand on their feet). We analyzed the care videos of Humanitude instructors to extract multimodal communication features. We designed and filmed video contents demonstrating the extracted features. These have shown to be effective, in combination with practice and reflection, to acquire dementia care skills. The trainees could use the system for self-reflection and teaching.

Introduction

The aging society is most significant in Japan. Consequently, there is growing social concern about the increasing number of people with dementia and how to provide quality care for them. Suitable situation-based care is required for each person with dementia in the caring field. Communication skills training in dementia care review shows that specific communication skills enhance the quality of life of people with dementia and increases positive interactions in various care settings (Eggenberger, Heimerl, and Bennett 2013). As the dementia care skills are difficult to visualize

and describe, they are difficult to acquire and the training system is insufficient. Our purpose is to apply a visualization system to trainees for effective acquisition of dementia care skills. As a complementary advance in the field of sports, video material analyzed could capture the complexity of coaching behaviors and thereby assist in taking significant steps towards guiding coaches to useful pedagogical practices (Nelson, Cushionb, and Potrac 2013).

For developments in nursing e-learning systems, King *et al.* (2014) designed the e-learning environment called Understanding Dementia MOOC. Majima *et al.* (2014) used a social network system and built a new learning system for improving practical nursing skills. Liaw *et al.* (2015) developed a web-based simulation using a variety of instructional strategies, including animation video, virtual patients and online quizzes for enhancing nurses' competencies in acute care.

Visualization tools are also being developed for learning care skills. Mangos and Bodaghee (2014) created a visualization tool for optimizing the parameters of an adaptive training system. Nakamura *et al.* (2015) developed a training video using multiple cameras and by editing the videos into a single-stream video for learning caregiving from typical important points of view. However, for acquiring care skills, there remains a need to model and visualize the instructors' practical knowledge. In this paper, we describe the visualization of dementia care skills based on multimodal communication features, augmented by the instructors' attentional factors.

A dementia care method to construct the human relationships

Caring for a person with dementia

Dementia is a set of symptoms that may include memory loss and difficulties with thinking, problem-solving or language. Dementia is caused when the brain is damaged by diseases, such as Alzheimer's disease and so on. Behavioral and psychological symptoms of dementia (BPSD), also known as neuropsychiatric symptoms, represent a heterogeneous group of non-cognitive symptoms and behaviors occurring in a subject with dementia. BPSD include loitering, agitation, anxiety, irritability, depression, apathy, delusion, hallucinations, and sleep or appetite changes (Cerejeira, Lagarto, and Mukaetova-Ladinska 2012). Fig 1 shows the rough mechanism of BPSD. The causes of BPSD are not clear but friction interaction between a person with dementia and his/her environments may trigger the changes in behavior. In other words, BPSD can be improved by removing frictions such as uneasiness and dis-tastefulness through environmental coordination and a non-pharmacological approach (Honda, Marescotti, and Gineste 2013; Delmas 2013; Ito et al. 2015).

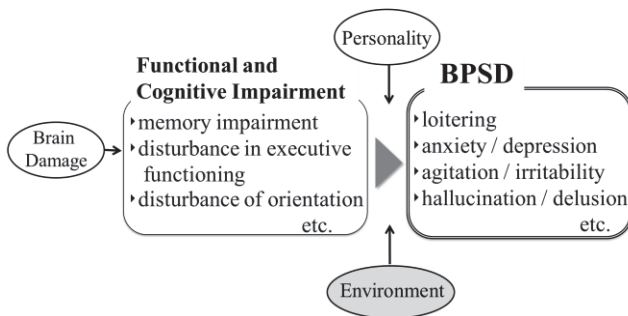


Fig. 1: The rough mechanism of behavioral and psychological symptoms of dementia (BPSD).

A multimodal communication care method: Humanitude®

Humanitude is a non-pharmacological comprehensive intervention with verbal and non-verbal communication, which is a care method that originated in France for vulnerable elderlies. The concept of Humanitude is based on the notion of well-being; it shows how behaviors and simple actions that reach the most essentially human core in people are effective (Gineste 2007). The methodology is consistent with four fundamental techniques to communicate with people with dementia: “gaze”, “speech”, “touch” and “assistance to stand up”. Table 1 shows the features of the first three of these techniques,

which are used in almost all care situations. Although the four techniques seem very simple, they contain a lot of implicit knowledge of care practitioners.

Table 1: The skill of Humanitude

Fundamental techniques	Details of technique
gaze	target of gaze, horizon, verticality, distance, duration e.g. a care practitioner gazes the elderly's eyes for a long time at the front.
speech	frequency, prosody, contents of utterances e.g. a care practitioner speaks frequent positive words by gentle voice.
touch	where to touch, how to touch, stroke e.g. a care practitioner touches the elderly's body softly and widely.

Video reflection to learn dementia care skills

In the training of Humanitude, the instructors point out ways to improve care technique and other approaches by using video data of trainees' care practice. After training, we administered an interview survey to 40 trainees, asking what they think about the training style. From the interview, we received positive opinions as follows:

- “I’m aware that what I felt right was wrong.”
- “I felt regular self-reflection using video with instructors comment can improve our quality of care technique.”
- “Instructors point out what went right, what went wrong, what had to be done, and what should be done in the future. I learned a lot from this training.”
- “I was able to objectively confirm my care approach to a care-receiver.”

After that, all members said instructors' comments on video are excellent. From the survey, we can expect that video-based self-reflection with instructors' comments is good for trainees to learn communication care skills.

The review of a recorded videotape of a simulation session with verbal discussion can help technical nursing skills (Eun 2014), increases desired nursing activities (Grant *et al.* 2010), and promotes problem solving ability (Patricia *et al.* 2013). In the field of sports, recent education and coaching development suggests video may serve as a tool for overcoming a number of perceived hurdles to the self-reflection process (Tippaya *et al.* 2015; Mead 2015). For teaching and teacher education, video reflections increased teachers' desires to change their teaching; when teachers could see the need for improvement with their own eyes, they reported that they could no longer deny or pretend that their teaching did not need improvement (Tripp and Rich 2012; Marsh and Mitchell 2015). There is a lot of information in video, and thus it is difficult to no-

tice which parts are important or not. For that reason, novice learners rarely notice the same features and meaningful patterns of information that instructors notice. So, our purpose is to visualize and model the instructors' implicit knowledge. Then we suggest an active learning environment for trainees shown in Fig 2. As the first step, we discuss the skill representation used to evaluate the quality of caring skills via a video analysis.

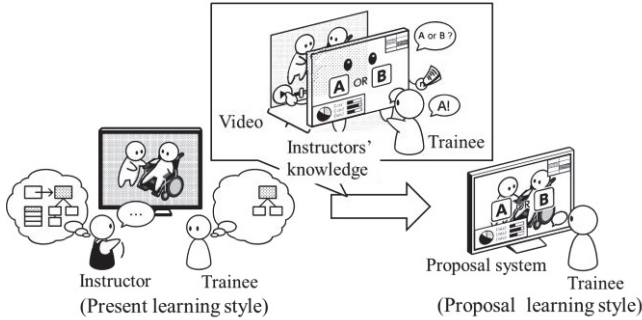


Fig. 2: An approach for learning dementia care skills.

The representation of multimodal communication care skills

We developed a tool for multimodal behavior analysis, as shown in Fig 3, to represent skills at the caring site, with descriptions by care experts' experience and comments (Ishikawa *et al.* 2015). We designed three layers for the skill representation and named them "Intra-modality", "Inter-modality" and "Multimodal-interaction". Intra-modality is the smallest unit of the four features, such as "gaze", "speech", "touch" and so on. Inter-modality is the unit linking Intra-modalities, such as waiting for elderly people's actions and consistencies. Multimodal-interaction is the unit of developing relationships between care practi-

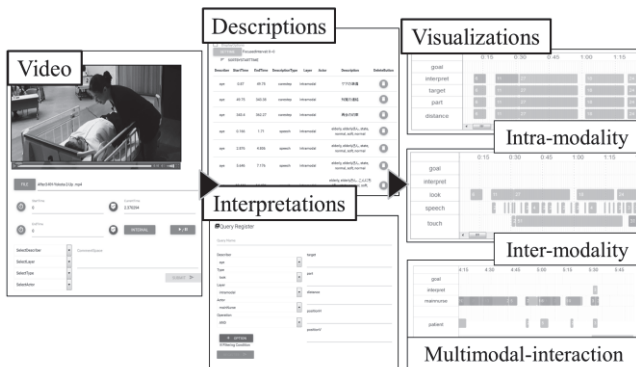


Fig. 3: A tool for multimodal behavior analysis.

tioners and people with dementia, such as eye contact and verbal/nonverbal dialogue. The framework enables us to represent the techniques of dementia care. Accordingly, by extracting multimodal communication features, we have developed a visualization system that reinforces the importance of communication skills.

The visualization of multimodal communication features

A learning process of dementia care skills

We visualized the communication features based on "The Emotion Machine", by Marvin Minsky (2007). We focus on Minsky's six-level model of mind, as shown in Fig 4. Fig 4 also shows how care practitioners think when they approach and give attention to people with dementia. Before executing an action, care practitioners repeatedly recall earlier experiences to anticipate likely reactions/ results. That is one of our six-level models of mind "Reflect Thinking Level" work, when we recall our earlier thoughts and proceed to think about them. Next, for "Deliberative Thinking Level" work, we use a collection of three-part If + Do→Then rules, where each if describes a situation, each Do describes a possible action, and each Then depicts what might be a possible result of doing that action. We use If + Do→Then rules, then compare the results that those rules predict. Finally we select the most appropriate alternative. When we repeat using reflect thinking and deliberative thinking, we can react to events "without thinking" as though we were driven by If→Do rules. When care practitioners approach people with dementia, they need to decide instantly the most appropriate alternative. For that reason, care practitioners need to think about whether their

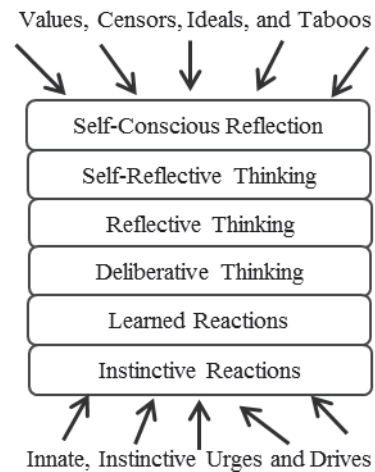


Fig. 4: Minsky's six-level model of mind.

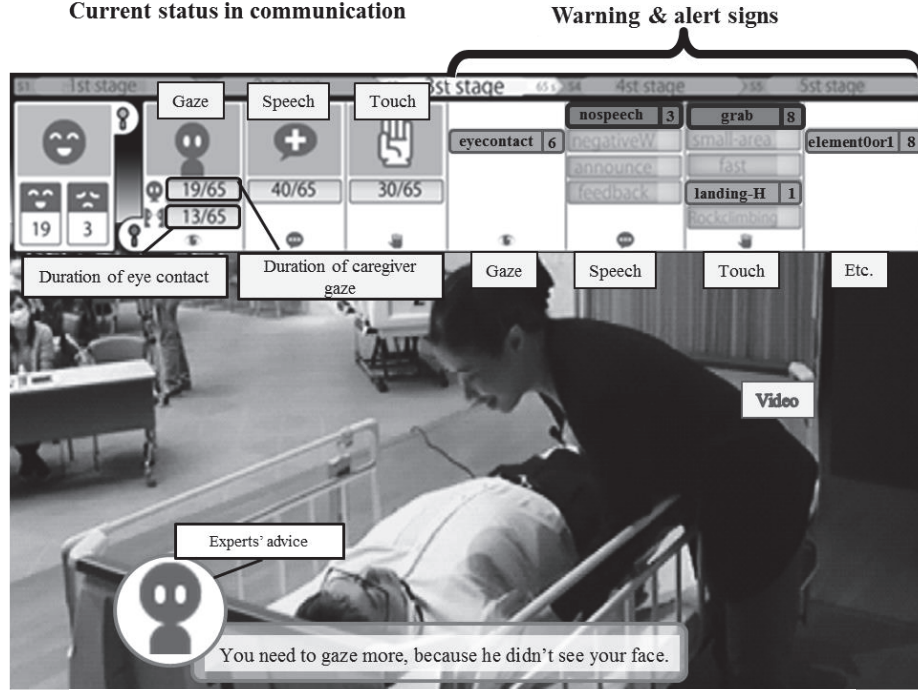


Fig. 5: The visualization view of video contents.

care process is appropriate and acceptable care. So, we designed the learning model to support trainee deliberative thinking and reflective thinking.

The extraction of multimodal communication features

In this part, we extracted communication features, especially to support trainee reflective thinking and deliberative thinking. So, we analyzed the video of Humanitude care with the instructors by using the system shown previously in Fig 1. We performed regular conferences and evaluate the extracted features three times. As the result of this evaluation, we selected the most important points that trainees should learn. Then, we decided the alert features and warning features for the trainee. According to the analyzed data, we extracted 37 multimodal communication features. Table 2 shows examples of the features. For examples, touch modality: if the caregiver uses thumb-based grasp with a lifting motion on the care receiver's hand, it is interpreted as an act of grabbing and gives a negative message to the care receiver. Touch is communication of the caregiver and it always has a meaning. So, we interpret it as an alert when a caregiver uses a thumb. Comprehensive intervention with verbal and non-verbal communication is important to build a relationship with people with dementia. So, if caregiver use none or only one of three modalities (gaze, speech,

touch), we interpret as warning. The 37 features are the most fundamental skills for the trainees to acquire.

Table .2: Examples of multimodal communication features

Modality	Behavior primitives	Interpretations of alert or warning
Gaze	•distance •horizon •verticality	•distance ($x > 20\text{cm}$) and horizon (left/right) and verticality (upper)
Speech	•category •pitch •loudness	•category (denial, warn, apologize) •loudness (true)
Touch	•speed •using thumb •stroke •through materials	•using thumb (true) •stroke (fast)
Comprehensive	•gaze •speech •touch	•0 or 1 of 3 modalities

The visualization of multimodal communication features

Fig 5 shows the visualization view of the video contents. The left side of upper layer of the care video in Fig 5 shows a table of current communication features. That layer details visualized trainee care techniques and the care

receiver's situation. The right side of the upper layer in Fig 5 shows warning and alert signs. These signs are generated by converting timeline data into the instructors' interpretations. Warning and alert signs can promote trainee deliberative thinking about which approach is appropriate. The lower layer in Fig 5 shows comments from instructors which can't be explained in the upper layer. Instructor comments lets trainees think about their ideal of care. So, the comments can stimulate one of our six-level model of mind "self-conscious reflection" that enables us to think about our "higher" values and ideals (Minsky 2007). The visualizations can give awareness to trainees about how to use the multimodal communication skills and can then support trainee to stimulate deliberative thinking and reflective thinking. The visualization system also supports instructors' explanations to trainees. The visualization system provides the following functions: 1) video upload, 2) generates the multimodal communication features for which trainees should look, 3) shows the instructors' advice. The system could give the trainees awareness of the important points of communication skills.

A preliminary evaluation for learning dementia care skills

The evaluation of the accuracy of communication features

We evaluated the accuracy of multimodal communication features which are described in video contents.

Procedure

Two care video contents were used for evaluation. Table 3 shows the detailed information of the videos' contents. The experiment was performed by six instructors (A-F). In the first step, we explained the way of using video contents to each participant. The participants watched the video contents and gave comments about communication features. The participants can pause the video contents when they comment. We did not show the lower layer of video content in Fig 5 so as to evaluate the accuracy of communication features. After watching both video contents, they responded to an interview of about five mins.

Table .3: The information of video contents

Name	Length of video	Numbers of warning/alert	Times of warning/alert
Video A	11:36 mins	9	76 times
Video B	05:19 mins	5	15 times

Result

There was no comment for warning and alert signs shown on two video contents. About the result of the interview,

we got positive opinions as follows: "video contents show not only the current status in communication but also show warning and alert signs. Because of that data, trainees can't deny or pretend that their care approach did not need improvement," "video content can point out detail of communication features. It helps when instructors point out care approach to trainees." The result shows that the extracted communication features can represent a fundamental of multimodal communication care skills.

Table .4: Numbers of instructor comments for video contents

Instructor	A	B	C	D	E	F
Numbers of Comments for Video A	4	1	0	0	3	4
Numbers of Comments for Video B	4	1	3	2	4	5

On the other hand, we also got comments that can't be represented by warning and alert signs. Table 4 shows the comments for two videos. We classified the comments into three groups shown in Table 5. For examples, the group of environment is follows as: "confirm the place of bed controller and so on," "adjust appropriate bed height," "find appropriate place to put care tool." If the bed height is low, it is difficult to construct a personal relationship with people with dementia. Furthermore, it will damage the care practitioners' hip. Instructors' comments show that the condition of the environment, individual features of the care practitioner, and the condition of the care receiver are also important features for learning dementia care skills.

Table .5: The group of instructors' comments

Group of Comment	Type	Numbers of Comments
Environment	4	14
Individual features of care practitioner	3	7
Condition of people with dementia	2	10

The evaluation of the utility of video contents

We did a preliminary evaluation of the visualization of dementia care for the effective acquisition of multimodal communication skills.

Procedure

Trainees supplied practice care videos. We enhanced the care videos with multimodal communication features that trainees should look for with the instructors' advice. Then, we returned that video content to the trainees. They reflected on their care by using the video content. After one month, we conducted a survey in four nursing homes (a total of eight people).

Result

The questionnaire has three questions with a point scale, two multiple-choice questions and five questions with free description. Examples of the point-scale questions are:

- “Is the video content useful for self-reflection?”
- “Is the visualization necessary for care learning?”

On a scale of 1 (yes) to 4 (no) all respondents selected 1. From the free description, we received positive opinions as follows:

- “The visualized icons of video contents are effective for learning the Humanitude care method.”
- “The visualization of video content made us aware of our care.”
- “Video contents are useful for teaching Humanitude care method.”

Video contents with the instructors’ interpretations are useful for self-reflection, and it reinforces the importance of communication skills. These results demonstrate that our visualization system is useful for acquiring dementia care skills.

Promote learning dementia care skills

Our developed system can support the reflective thinking of care practitioners and can provide effective learning for dementia care skills. Dementia care skills based on multimodal communication features is continually improving. Fig 6 shows the multimodal dementia care knowledge corpus continuously updating the dementia care skills knowledge. By this cycle we can contribute to the construction of care practitioners’ tacit knowledge to explicit knowledge. This cycle also promotes trainee learning and leads to continuous learning.

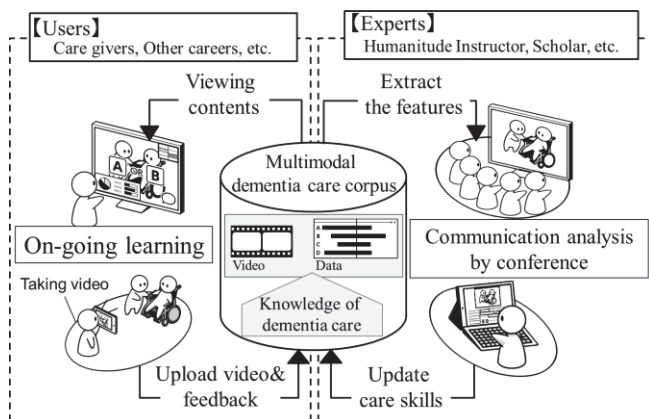


Fig. 6: Multimodal dementia care knowledge corpus.

Conclusion

In this paper, we extracted and visualized the multimodal communication features. The results suggest that video contents with visualized data is useful for trainees when they are learning dementia care skills, and that it can give them awareness of the importance of communication techniques. We evaluated the accuracy of extracted multimodal communication features and then collected comments for improving the visualization system. Because this study is a preliminary evaluation and very limited, we will continue practice in the field.

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